
CVEN 4525/5525

Intermediary Structural Analysis

(a.k.a Matrix Structural Analysis)

Fall 2017

Aug. 27 2017

INSTRUCTOR

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Office hours: Anytime.

LECTURES

Lectures: T,R 11 :00-12 :15 ECCR 135

PREREQUISITES

Introductory course in structural analysis (CVEN 3525) or equivalent, matrix algebra, basic computer programming (MATLAB).

LECTURES

Lectures: T,R 11 :00-12 :15 ECCR 135

EMAIL/WEB

I will communicate with you by e-mail, and documents will also be stored in the course web-site,
<https://piazza.com/colorado/fall2017/cven45255525/home>

HOMEWORKS

You have the choice of submitting your assignment individually or in groups of 2 on the due date before the lecture begins. Late submission of assignments will result in loss of 10% points per day; after the solution is posted (on the third day), no points can be earned for that assignment. Homework assignments will be graded both for numerical answers and conceptual understanding – so don't worry too much if you made a calculation error but your thought processes are correct!

SOFTWARE

You are strongly recommended to familiarize yourself with the following software packages Matlab and Mathematica. We will be using them extensively throughout the semester. Alternatively, you may want to use Python.

REFERENCES

McGuire, W., Gallagher, R.H., Ziemian, R.D., Matrix Structural Analysis, John Wiley and sons, 2nd edition, 2000.

Pilkey, W.D., Wunderlich, W. Mechanics of Structures, Variational and Computational Methods, CRC Press, 2nd Ed. 2002;
e-copy: <http://www.crcnetbase.com/ISBN/9781420041835>

OBJECTIVES

Most introductory courses in structural analysis limit themselves to the fundamentals (and many topics that will never be used in practice). Then, the student is propelled to the finite element analysis method. Left in between are numerous

topics which understanding is essential for a well trained Structural Engineer. This includes analytical solutions for complex structures, cables, arches, shells, and the interaction between analysis and design.

Then, engineers will invariably be using computer programs for the analysis of structures (typically framed, as opposed to continuum). Hence, it is essential that they be exposed to the theoretical and computational underpinnings of those tools in both the linear and nonlinear range.

The material in CVEN 4425/5525 forms the basis for several courses in the SESM program. It also appears in the MS Comprehensive exams, and in the Ph.D. Preliminary and Comprehensive exams.

COVERAGE (TENTATIVE)

Not necessarily in this order!

1. Introduction to structural engineering, the “big picture”.
2. Review and advanced coverage of:
 - a. Forces.
 - b. Reaction.
 - c. Internal forces.
 - d. Principle of complementary virtual work.
 - e. Interaction between analysis and design.
3. Force displacement relationships (axial, flexure, shear and torsion).
4. Element stiffness matrix.
5. Direct stiffness method, Orthogonal structures.
6. Coordinate transformation.
7. Direct stiffness method (theory/programming).
8. Arches and Shells.
9. Variational Methods, Euler Equation, Principles of Virtual work
10. Shape functions; Element stiffness matrix formulation based on PVW.
11. Stability (Buckling).
12. Dynamic analysis.
13. Nonlinear analyses.
 - a. Geometric.
 - b. Material.

EXAMS

There will be one midterm exam (date tbd) and a comprehensive final exam.

SOFTWARE

You are strongly recommended to familiarize yourself with Matlab and Mathematica. Note: superficial working knowledge of Matlab will not be enough, handouts on “advanced programing techniques” will be given.

PROJECTS

Mini Project 1: Write a simplified computer programs for matrix structural analysis of 2D and 3D structures

Mini Project 2: You have the choice between generalizing your computer code using modern programing techniques in Matlab or developing a topic of interest to be discussed with instructor.

GRADING

Grading will be based on the following weights:

- Homework: 20%

- Term Project: 20%
- Midterms: 40%
- Final Exam: 20%

The final grade will depend on the three highest individual point totals for the course. The final letter grade that you get is determined by taking your point total and putting it in one of these bins.

Letter Grade	A	A-	B+	B	B-	C+	C	C-	F
Range of Point Total	h*.100	h*.939	h*.919	h*.899	h*.819	h*.799	h*.779	h*.719	<h*.699
	h*.940	h*.920	h*.900	h*.820	h*.800	h*.780	h*.720	h*.700	

COMMENTS

I am always happy to meet with you to discuss your progress in the course or suggestions for how the class can be improved. Please feel free to stop by during office hours or to schedule an alternative appointment. Also, be sure to speak up in class if you have questions or you think I've made a mistake – it is likely someone else has the same question!

OTHERS

ACCOMMODATION FOR DISABILITIES

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website (www.colorado.edu/disabilityservices/students). Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website and discuss your needs with your professor.

RELIGIOUS HOLIDAYS

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, {{insert your procedures here}}

See the campus policy regarding religious observances for full details.

CLASSROOM BEHAVIOR

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the Student Code of Conduct.

SEXUAL MISCONDUCT, DISCRIMINATION, HARASSMENT AND/OR RELATED RETALIATION

The University of Colorado Boulder (CU Boulder) is committed to maintaining a positive learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct, discrimination, harassment or related retaliation against or by any employee or student. CU's Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU Boulder's Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the OIEC website.

HONOR CODE

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the academic integrity policy. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, resubmission, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code Council as well as academic sanctions from the faculty member. Additional information regarding the academic integrity policy can be found at the Honor Code Office website.